REMARKS

Claims 109-116 are currently pending in the present application.

Applicant acknowledges with appreciation the Examiner's withdrawal of the rejection of claim 109 under 35 U.S.C. §102(b).

Applicant requests reconsideration of the present application in view of the following remarks.

THE REJECTIONS

I. Double Patenting Rejections

The Examiner has rejected claims 109-116 under the judicially created doctrine of obviousness-type double patenting, as allegedly being unpatentable over claims 72-83 of United States Patent 6,417,422. The Examiner has also rejected claims 109-111 under the judicially created doctrine of obviousness-type double patenting, as allegedly being unpatentable over claims 9 and 41 of United States Patent 6,355,854.* And, the Examiner has provisionally rejected claims 109-111 under the judicially created doctrine of obviousness-type double patenting, as allegedly being unpatentable over claims 24 and 56 of co-pending United States application 09/815,914.

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* Applicant understands that the Examiner intended to cite commonly-assigned United States Patent 6,355,8<u>54</u> and not United States Patent 6,355,8<u>45</u>.

Applicant will file a Terminal Disclaimer in compliance with 37 C.F.R. §1.321(c) upon notice that the claims are otherwise in condition for allowance.

II. Rejections under 35 U.S.C. §103(a)

1. The Examiner has rejected claim 109 under 35 U.S.C. §103(a), as allegedly being unpatentable over United States Patent 4,524,236 ("McCain").

The Examiner asserts that "McCain discloses an oxydehydrogenation process to convert alkanes (e.g., ethane) to alkenes (e.g., ethylene) by contacting the alkanes, in the presence of oxidizing agent, with a catalyst comprising nickel." Office Action, page 4. The Examiner further asserts that, "since the reaction has a conversion of greater than 60%, the product would have a concentration of alkenes greater than 5% relative to total moles of hydrocarbon." Ibid. The Examiner acknowledges that "McCain does not disclose that the feedstock comprises at least 5% of alkene." Office Action, page 5. The Examiner, however, asserts that "it would have been obvious to one having ordinary skill in the art at the time of the invention was made to have modified the process of McCain by using a feedstock comprising at least about 5 % of alkene as claimed because McCain teaches that the feedstock comprises less than 5 vol. % of alkene." Ibid. The Examiner concludes that "one of skill in the art would use a feedstock comprising about 5 molar % of alkene because it would be expected that small change in the amount of alkene in the feedstock would not affect the outcome of the process." Ibid. Applicant traverses.

The invention defined by claim 109 is a method for preparing an alkene from the corresponding alkane using a catalyst comprising nickel in which the reaction zone comprises an alkene ***during*** oxydehydrogenation. The claim requires that the alkane conversion be at least about 5% and the alkene selectivity be at least about 50%. A significant aspect of applicant's claimed invention is the improved performance characteristics, *i.e.*, selectivity and conversion, for the conversion of alkanes to alkenes ***even*** in the presence of substantial amounts of alkene in the reaction zone. The improved performance characteristics are surprising, particularly with respect to ethane conversion, because ethylene is typically ***more*** reactive than ethane. See, e.g., specification page 23, lines 4-21.

McCain does not teach or suggest the method of claim 109. McCain generally discloses a method for the oxydehydrogenation of ethane to ethylene using a calcined oxide catalyst containing Mo, V, Nb, Sb, and X, where "X" may be nickel oxide. In particular, the McCain method uses a reaction mixture that contains ethane, molecular oxygen and water. Col. 5, lines 8-17. The mixture may also contain other gases, such as, nitrogen, helium, carbon dioxide, and methane, as reaction diluents or heat moderators. Col. 5, lines 19-21. In the McCain method, the gaseous components of the reaction mixture are uniformly admixed ***prior*** to being introduced into the reaction zone. Col. 5, lines 32-34. In fact, McCain expressly specifies that the feed composition should have less than 5% alkene, stating that the ethane-containing feed is a gas stream that

> "can also contain minor amounts of hydrogen, carbon monoxide, and the C_3-C_4 alkanes and alkenes, ***less than five volume percent of each.***"

Col. 5, lines 1-4 (emphasis added). Even if the Examiner's assertion that "the product would have a concentration of alkenes greater than 5% relative to total moles of hydrocarbon" were true, that is not a disclosure that alkene is present ***in the reaction zone*** in a molar concentration of at least about 5% ***during*** oxydehydrogenation. This is evident, in particular, where McCain discloses effecting the reaction in a flow reactor. (*See* McCain, Col. 4, lines 65-66; also Col. 5, lines 44-47). Thus, McCain does not teach or suggest that the reaction zone contains alkene ***during*** oxydehydrogenation as required by claim 109.

Not only does McCain fail to teach or suggest all the elements of claim 109, but there is also no motivation to modify McCain to produce a method in which the reaction zone comprises 5 molar percent of alkene during oxydehydrogenation. The Examiner's motivation to modify is premised on the McCain disclosure that the feedstock may contain less than five volume percent of alkene and that "a small change in the amount of alkene in the feedstock would not affect the outcome of the process." The Examiner's premise is misguided. One of ordinary skill in the art would readily recognize that increasing the amount of alkene in the feedstock would in fact affect the outcome of the process. This is especially true with respect to ethane conversion because ethylene is typically more reactive than ethane over most catalysts. See, e.g., specification page 23, lines 4-21. Thus, McCain fails to provide the requisite motivation to provide an oxydehydrogenation process in which the reaction zone

comprises alkene in a molar concentration of at least about 5%, relative to total moles of hydrocarbon, during the oxydehydrogenation.

Further, at the time of applicant's invention there was also no reasonable expectation of success in oxydehydrogenation methods in which the reaction zone comprises alkene during oxydehydrogenation with high selectivities and conversions. This is evident by the product-sensitivity of most catalysts. In particular, and as discussed above, alkenes, such as ethylene, are typically more active than the corresponding alkane over most catalysts. See, e.g., specification page 23, lines 4-21. It was applicant's discovery that nickel-containing mixed-metal oxide catalysts have high selectivities and conversions for converting alkanes to alkenes ***even*** in the presence of substantial amounts of alkenes in the reaction zone.

Accordingly, the Examiner has failed to establish a prima facie case of obvious because McCain does not teach or suggest a method for preparing an alkene in which the reaction zone comprises an alkene ***during*** oxydehydrogenation, there was no motivation to modify McCain to produce such a method and there was no reasonable expectation of success in producing such a method. Thus, this obviousness rejection should be withdrawn and claim 109 should be allowed.

2. The Examiner has rejected claim 109-111 under 35 U.S.C. §103(a), as allegedly being unpatentable over McCain in view of United States Patent 5,043,461 ("Ramachandran"). The Examiner acknowledges that "McCain does not disclose that the

feedstock comprises at least 5 molar % of alkene and does not disclose a step of adding or recycling alkene to the reaction zone." Office Action, page 5. The Examiner asserts that "[i]t would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the process of McCain by co-feeding a C2-C4 alkene to the reaction zone as taught by Ramachandran (See Fig. 4-7; Col. 4, lines 6-7) because Ramachandran discloses that the step of recycling alkene to the reaction zone would increase the overall process efficiency." The Examiner then concludes that "the process of McCain would have the feedstock comprising at least 5% of alkene." Ibid. Applicant traverses.

As detailed above, McCain does not teach or suggest a method for preparing an alkene in which the reaction zone comprises an alkene ***during*** oxydehydrogenation. The failure of McCain to teach or suggest all the elements of claim 109 is in no way cured by the teachings of Ramachadran. Thus, the combination of McCain and Ramachandran fails to render claims 109-111 obvious.

Ramachandran relates to a process for the production of ***oxides*** from hydrocarbons. In the Ramachandran method, propane is fed into a dehydrogenator where it is converted to propylene in the presence of a conventional dehydrogenation catalyst. Col. 6, lines 21-30. The dehydrogenation catalyst is preferably one or more Group VIII noble metals such as platinum on an alumina support. Ibid. Preferably, the propane is fed into the dehydrogenator with a hydrogen-containing gas. Ibid. The effluent product stream

comprising unreacted propane, propylene and hydrogen is then fed into a conventional oxidation reactor along with pure oxygen, air, preferably oxygen-enriched air and ammonia. Col. 6, lines 30-35. The reactor may contain a suitable oxidation catalyst such as silver oxide, molybdenum oxide, ruthenium oxide or lanthanum oxide, alone or in combination with others. Col. 6, lines 41-45. The effluent from the oxidation reactor is quenched and introduced under pressure into a conventional absorber/stripper unit. Col. 7, lines 3-15. The absorber/stripper unit produces a waste stream, which is preferably incinerated, and a recycle stream. Col. 7, lines 31-34. The recycle stream contains unreacted alkane and alkene, as well as a minor quantity of oxygen. Col. 7, lines 35-38. The recycle stream is introduced into a selective oxidation reactor containing an art-recognized catalyst for the selective reaction of oxygen and hydrogen to form water. Col. 7, lines 43-45.

Nowhere does Ramachandran disclose specific dehydrogenation catalysts, let alone disclose catalysts containing nickel. Nor does Ramachandran disclose a method for preparing an alkene in which the reaction zone comprises an alkene ***during*** oxydehydrogenation. Therefore, Ramachandran, like McCain, does not teach or suggest every element of claims 109-111.

For at least the reasons above, the combination of McCain and Ramachandran does not render obvious applicant's claimed invention. Accordingly, applicants request that the Examiner withdraw this rejection under 35 U.S.C. §103(a).

3. The Examiner has rejected claim 112-116 under 35 U.S.C. §103(a), as allegedly being unpatentable over McCain in view of either United States Patent 6,548,697 ("Ellis"), Ramachandran or United States Patent 5,439,859 ("Durante"). The Examiner acknowledges that "McCain does not disclose a second reaction zone, [sic] does not disclose a step of controlling the concentration of oxygen in the first and second reaction zone." Office Action, page 5. The Examiner asserts that "Ellis, Durante, and Ramachandran disclose a process for producing alkene by utilizing multiple reaction zones." The Examiner concludes that "[i]t would have been obvious to one having ordinary skill in the art at the time of the invention was made to have modified the process of McCain by utilizing a second reaction zone as taught by Ellis, Durante, and Ramachandran because using additional reaction zone would improve the over all [sic] conversions of the process." Ibid. The Examiner also concludes that "[i]t would have been obvious to one having ordinary skill in the art at the time of the invention was made to have modified the process of McCain by controlling the concentration of oxygen in the first and second reaction zones as claimed because the process of McCain is operated at high conversions and high selectivity as claimed." Ibid. The Examiner further concludes that "it is within the level of one having ordinary skill in the art to control the concentration of oxygen so that the process is maintained at high conversions and high selectivity." Applicant traverses.

As an initial matter, applicant respectfully submits that Ellis is not prior art to the present claims. In particular, Ellis is not prior art under 35 U.S.C. §§ 102 (a) or (b)

because it issued on April 15, 2003, which is after the effective filing date of the present application. Nor is Ellis prior art under 35 U.S.C. § 102(e) because its effective filing date is September 28, 2001, which is also after the effective filing date of the present application. Thus, Ellis is not a proper 35 U.S.C. § 102 reference against applicant's claims, and, consequently, cannot be used as an obviousness reference under 35 U.S.C. § 103.

Applicant's invention, as defined by claims 112-115, is a method for preparing an alkene from the corresponding alkane using a multi-stage reaction system. The claims require co-feeding a gaseous oxidant and an alkane to a first reaction zone and dehydrogenating the alkane to an alkene using a nickel containing catalyst. The claims also require exhausting the product stream comprising the alkene and unreacted alkane from the first reaction zone and co-feeding the product stream and a gaseous oxidant to a second reaction zone and dehydrogenating the alkane to an alkene. The combination of McCain and either Durante or Ramachandran does not render applicant's invention obvious.

As detailed above, McCain relates to a process for oxydehydrogenation of ethane to ethylene using a calcined oxide catalyst containing Mo, V, Nb, Sb, and X, where "X" may be nickel oxide. As the Examiner acknowledges, McCain does not teach or suggest a second reaction zone, as required by claims 112-115.

Ramachandran also does teach or suggest the all the elements of claims 112-115. As discussed above, Ramachandran relates to a process for the production of oxides from

hydrocarbons. Nowhere does Ramachandran make any mention of specific dehydrogenation catalysts, let alone nickel containing catalysts. Nor does Ramachandran make mention of co-feeding a gaseous oxidant and an alkane to a first reaction zone, or dehydrogenating the alkane in the second reaction zone.

The failure of Ramachandran and McCain to teach or suggest all the elements of claims 112-115 is in no way cured by the teachings of Durante. Durante relates generally to catalytic dehydrogenation of alkanes. Col. 1, lines 7-8. In the passage cited by the Examiner at page 6 of the Office Action, Durante relates to a multi-step process for dehydrogenation of alkanes in which alkane and hydrogen mixtures are passed through alternating endothermic catalytic dehydrogenation zones and at least one exothermic catalytic oxidation zone. See, Col. 5, lines 33-35. In the Durante method, alkane-containing feed is contacted with a dehydrogenation catalyst in each of a plurality of dehydrogenation zones to produce hydrogen and dehydrogenated hydrocarbon. Col. 5, lines 28-33. The catalyst employed in the dehydrogenation zones may be a known catalyst for dehydrogenation of alkanes. Col. 6, lines 28-33. Alternatively, the catalyst may be a sulfided catalyst containing nickel and an optional modified such as tin, chromium, copper or other compounds, or a catalyst containing sulfided nickel supported on a carbon coated metal oxide support. Col. 2, lines 40-51 and 3, lines 57-60. Next, the hydrogen and dehydrogenated hydrocarbon are contacted with an oxidation catalyst and an oxygen-containing gas in each of the oxidation zones to selectively oxidize a portion of the stream and generate heat. Col. 5, lines 40-44. The effluent from each oxidation

zone and the generated heat are then routed through another dehydrogenation zone to produce additional hydrogen and dehydrogenated hydrocarbon. Col. 5, lines 44-47. Hydrogen is separated from the reactor effluent in a separate process step using known methods, and a portion of the separated hydrogen is recycled with fresh feed and/or unreacted hydrocarbon feed to a dehydrogenation zone. Col. 5, lines 47-53.

Nowhere does Durante make any mention of co-feeding a gaseous oxidant and an alkane to a first reaction zone, as required by claims 112-115. Nor does Durante make mention of dehydrogenating the alkane in the second reaction zone, as required by claims 112-115. Thus, Durante fails to teach or suggest all the elements of claims 112-115.

For at least the reasons above, the combination of McCain and either Ramachandran or Durante does not render obvious applicant's claimed invention. Accordingly, applicants request that the Examiner withdraw this rejection under 35 U.S.C. §103(a).

CONCLUSION

In view of the foregoing remarks, applicant requests that the Examiner withdraw the claim rejections and allow all claims of this application. If the Examiner believes that an interview would facilitate the resolution of any outstanding issues, he is kindly requested to contact the undersigned.

Respectfully submitted,

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